

Closure of the Cyclostomatous Bryozoa.
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(PLATE XVII.)

As my description of the Australian fossil Chilostomata progressed, I have known that the Cyclostomata must shortly be dealt with, and have looked forward to this with feeling almost of dismay, because the Cyclostomata possess so few characters that can be used for the purposes of determination. In consequence, for some time sections of such Cyclostomata as were available were prepared and examined, to see what other points might be used for the purpose. Although the results are very small in proportion to the amount of work, yet I shall in my forthcoming paper to the Geological Society be able to point out that the ovicells ought to be very carefully examined, as there are more points of importance than have so far been used, and shall call attention to the connecting pores being comparable with the rosette-plates of the Chilostomata, and giving, by their position, useful characters. Stress must be laid upon the size of the zoecial tube, as this, as already pointed out by Smitt, seems to be constant in each species. The range in size of the zoecial tube is not very great; the smallest being only 0·03 millim., while some are nearly 0·2 millim.; but it is quite exceptional to find zoecia more than 0·14 millim., or less than 0·07 millim.

Besides these, there is another character which has never been understood and is quite neglected, and which may possibly be of great use; but to what extent, it is impossible to say at present. I refer to the position of the closure of the zoecial tube. As a correct understanding of it has a most important bearing not only upon a large number of living species, but also on several groups of fossils, some of which are still of a more or less problematic character, I am anticipating my descriptive paper by dealing with this at present, in order that it may be more fully studied from various stand-points by those who have the opportunity.

In the 'Crag Polyzoa,' p. 110, Mr. Busk speaks of the mouths of the tubes of *Mesenteripora* being eventually closed by a calcareous lid having usually a minute central perforation. Smitt figured the cover with a projecting tubule in what he called

Reticulipora nummulitorum, d'Orb., but which I afterwards named *R. dorsalis*, from Naples ("Bry. of Naples," Ann. & Mag. Nat. Hist. 1879, iii. p. 278, pl. xxiii. fig. 5), and figured a similar cover with a projecting tubule; and since then Mr. Hincks has figured the same thing in *Diastopora sarniensis* ('Brit. Polyzoa,' p. 463, pl. lxvi. figs. 7-9), and refers to their having been considered subservient to reproduction; but none of us fully appreciated that this closure is only a modification of what occurs in the zoœcial tubes of all Cyclostomata.

Mr. J. Young, in the 'Geological Magazine' (new series, vol. i.), called attention to *Polypora*, Carboniferous Bryozoa having the aperture nearly closed by a thin calcareous cover with a minute opening in the centre. These closures, which are nearly terminal, have been thought to be homologous with the radial denticles of *Glaucanome stellipora*; and the existence of this calcareous cover in Palæozoic Bryozoa has attracted considerable attention. In "Remarks on some Fenestellidæ," Manch. Geol. Soc. 1878, I mentioned, as bearing upon the last point, that "in the Cyclostomata the cells are often after a time closed by a diaphragm, in most cases some little distance down the tube;" and further examination enables me now to state that the position and the character of this diaphragm may be employed as a useful specific character.

The most usual position for the calcareous plate which closes the tube would seem to be about the point where the zoœcial tube rises free from the zoarium. This can very well be seen in what I call *Entalophora rugosa*, d'Orb., from Naples; and in successful sections we cut through this plate and see it as figured (Pl. XVII. fig. 3). In *Idmonea* the closure is usually in about the same position as in *E. rugosa*, while in *Crisia* it is terminal; and we have seen that in *Mesenteripora* and some *Diastopora* it is terminal with a projecting tubule, and in several Palæozoic fossils it is almost terminal.

Besides the position, we must also notice the character of this plate; for sometimes it has one opening, in other species there are a number of openings, as figured by Hincks in *Diastopora patina*, or there may be only very minute perforations, and it is apparently sometimes quite closed.

Mr. F. D. Longe published a paper in the 'Geological Magazine' (Jan. 1881), "On the Oolitic Polyzoa," in which he maintains that certain closures are the equivalents of the opercula of

the Chilostomata; but I do not think that there is any necessity for dealing in detail with the conclusions that Mr. Longe drew; for doubtless he will now consider that it is made clear that the structure of the movable horny operculum, and the calcareous plate across the opening of the Cyclostomatous tube, is very different. I would also point out that there are, as far as I have seen, differences of shell structure which distinguish the Oolitic Chilostomata and Cyclostomata; and a number of characters would enable the "race Diastoporidæ" of Longe, containing *Diastopora*, *Entalophora*, *Eschara*, and *Cellepora*, to be readily divided into their two suborders.

It will be noticed in the Plate (figs. 5 & 6) that sometimes instead of only one closure there are two quite close together. I am not able to give any definite explanation of this; but it must be looked upon as having a very important bearing upon the tabulæ in *Heteropora*; and *Heteropora* having been made the basis of comparison with the *Monticulipora* and allied fossils, these tabulæ should be very carefully examined.

Mr. Busk, in the 'Crag Polyzoa,' p. 122, speaks of partial transverse nearly equidistant septa"* in *Heteropora*; but unless properly made sections have been prepared, there is a great chance of being misled by appearances, and from fig. 2 of pl. xix. I feel no doubt whatever that there were no tabulæ in the part of the specimen figured by Mr. Busk, as I believe transparent sections would have shown, whereas apparently only a broken surface was examined.

As pointed out †, I have made many sections of *Heteropora* without finding tabulæ; and as their presence indicates a stage of growth or decay, they will not always be present. On the other hand, I have now found closures in a number of cases, usually only one in a zoecial tube; but besides the closures near to the circumference, there are sometimes others nearer to the centre of the zoarium; but in no case in recent, Tertiary, or Cretaceous Heteroporidæ have I found numerous tabulæ, whereas in what Haime calls *Heteropora conifera* I find the tabulæ most frequent, just as figured by Haime ('Bry. Jur.' pl. xi. fig. 2), and they only average about 0·2 millim. apart.

In *Heteropora (Multicavea) lateralis*, d'Orb., from Royan, I find

* This term septa has been objected to by Prof. A. Nicholson; and a protest must also be made against the term opercula for these plates.

† "Note on the Genus *Heteropora*," Ann. & Mag. Nat. Hist. vi. p. 156 (1880).

that one zoecial tube has a double closure (fig. 6), as mentioned above; and the same thing may be seen in a *Reticulipora* fossil from Aldinga, Australia, which I call *R. transennata*.

In a *Radiopora* from St. Croix these divisions, instead of being irregularly placed as in *H. conifera*, occur at longer intervals, and then in the neighbouring zoecia they are frequently at an equal distance from the centre of growth, thus forming, when slightly magnified, almost concentric lines cutting across a number of zoecia. The section of *Lichenopora boletiformis* shows the structure of an Australian fossil, which in its shape and general appearance partly resembles *Radiopora*; but the way in which it grows will be seen to be quite different. If we turn to Simonowitsch's 'Beit. z. Kennt. der Bryozoen des Essener Grünsandes,' I think we see both structures; for in fig. 4, pl. i., we seem to have a *Radiopora*, while figs. 2 and 3, pl. ii., seem to represent a *Lichenopora* growing like *L. cochloidea*, d'Orb., or *L. boletiformis*, d'Orb.; and in such cases there is probably a basal lamina as in the Australian fossil.

It certainly does not seem that we can in any way directly compare this immovable closure with the movable operculum of the Chilostomata; but at the same time the object may not be entirely dissimilar. To understand this, we must always keep in mind that with the death of the polypide, or perhaps it is better to say the absorption, the colony continues its life, and in the case of Chilostomata a new polypide may grow in the zoecium recently occupied; but to what extent this is the case in Cyclostomata I do not find any direct observations. Now if each zoecium during its polypideless condition could be choked up by the mud deposited from the sea, then the whole colony must suffer from the absence of the individual polypides which kept the living tissue free, and the death of the colony would result.

In the Cyclostomata, which are the simplest of the Bryozoa, a calcareous partition exists which closes the tubular zoecium, and thus protects the colony; whereas in the Chilostomata, which are more highly differentiated and, not being tubular, could more easily be closed up, there is the horny operculum, which is not a sign of death, but is movable, and protects the living polypide and through it the colony. I have already carried this idea further and applied it to avicularia (Quart. Journ. Geol. Soc. vol. xxxvii. p. 327, and vol. xxxix. p. 425); for the avicularia retain their life and power of movement when no polypide fills

the cell, and thus important tissues of the colony are kept in healthy contact with the exterior.

The form of the aperture in the Chilostomata has been recognized by all recent authorities as being of the first importance in determination; and I showed* that the opercula furnish the most reliable specific characters: and these, in the hands of Mr. Busk for *Cellepora*, and Professor MacGillivray for *Retepora*, have given most important results. In all examinations that I have made of fossils the shape of the opercular opening has always been studied where it was possible; and in the same way with the Cyclostomata the examination of the shape and size of the aperture and the nature of the closure is likely to extend our knowledge; and, further, it is only possible to check the naturalness of classification where many characters are available, for then the correlation of these characters will show when we are upon the right track. Such points as we have been dealing with can, however, only be made available by extended study, and my present work is not favourable for this; as with fossils, especially those sent from a distance, there is in many cases only one specimen, whereas there should be abundant material at hand, and in various conditions of growth.

DESCRIPTION OF PLATE XVII.

- Fig. 1. Section of *Radiopora* from the Valangian of St. Croix, Switzerland.
 2. Section of *Hornera concatenata*, Rss., from the Bartonian of Brendola, N. Italy.
 3. Section of *Entalophora rugosa*, d'Orb., recent, from Naples.
 4. Closure of *Reticulipora dorsalis*, Waters, recent, from Naples.
 5. Section of *Reticulipora transennata*, Waters, in present volume of Proc. L. Geol. Soc., fossil, from Australia.
 6. Section of *Heteropora (Multicavea) lateralis*, d'Orb., from the Senonian of Royan, France.
 7. Section of part of colony of *Lichenopora boletiformis*, d'Orb., fossil, from Aldinga, Australia. $\times 12$.
 8. Section of *Lichenopora boletiformis*, d'Orb. $\times 7$.

* "The Use of the Opercula," &c. Proc. Manch. Lit. & Phil. Soc. vol. xviii. No. 2, p. 8.



Fig. 1



Fig. 2

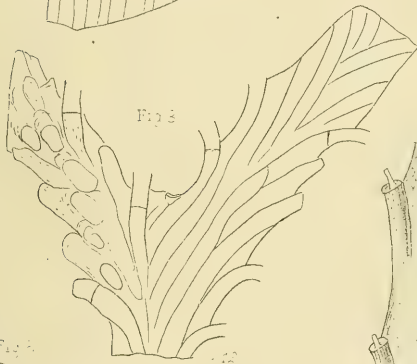


Fig. 3



Fig. 4



Fig. 5

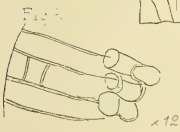


Fig. 6

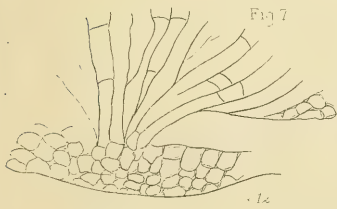


Fig. 7

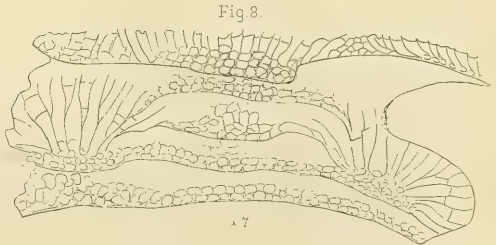


Fig. 8